

Turbopump Design for Deep Throttling Capability, Phase II

Completed Technology Project (2009 - 2013)



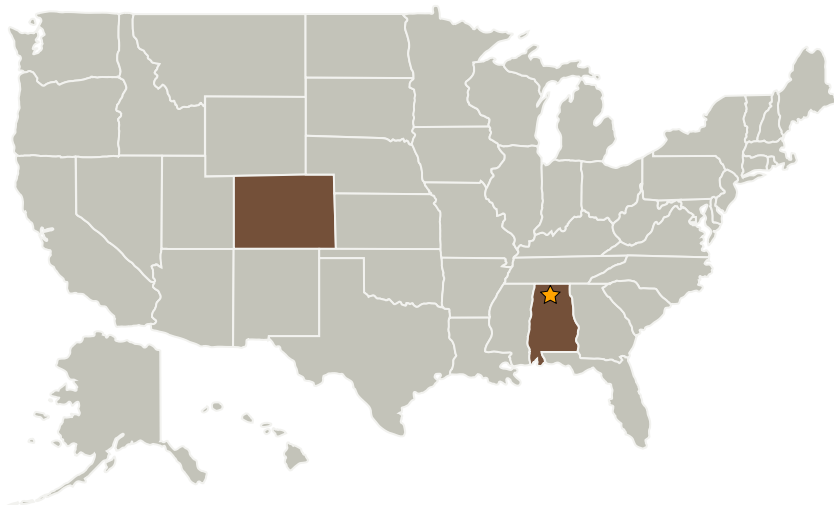
Project Introduction

This project will demonstrate the benefits of a partial emission pump coupled with a zero net positive suction pressure inducer design to achieve robust, deep throttling capability. This pump application is well suited for 5k to 15k lbf thrust range rocket engines.

Anticipated Benefits

Advancement in space exploration necessitates deep throttling of liquid cryogenic rocket engines. An engine that is capable of deep-throttling at low thrust levels and versatile enough to accommodate multiple applications would advance the "state-of-the-art" and enable NASA to meet its space exploration objectives. An advanced turbopump inducer/impeller design is an enabling technology for developing the required low thrust deep throttling engine needed to support future NASA missions. Commercial applications include pumps that can handle boiling fluids, both cryogenic and light hydrocarbons used in chemical process industries. These applications involve circulating pumps in multiple distillation columns where the NPSH can be one foot or less. The impeller and inducer design combination can be applied to commercial cryogenic pump applications for liquid hydrogen, liquid oxygen, and other systems and can be used in liquid rocket engine turbopump design can be used with cryogenic liquid rocket engines developed for space tourism vehicles. The turbopump design can be used for high speed, low suction head, light-weight SCRAMJET fuel pumping.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Barber-Nichols, Inc.	Supporting Organization	Industry	Arvada, Colorado

Primary U.S. Work Locations	
Alabama	Colorado

Project Transitions

**September 2009:** Project Start**March 2013:** Closed out

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Gary C Jahns

Principal Investigator:

Judy Busby

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Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.1 In-space Propellant Storage & Utilization